US ARMY AVIATION

FAA AVIATION NEWS

COVER:
Eyeballing the weather is an ancient art. For a basic review see page 10.

FAA AVIATION NEWS

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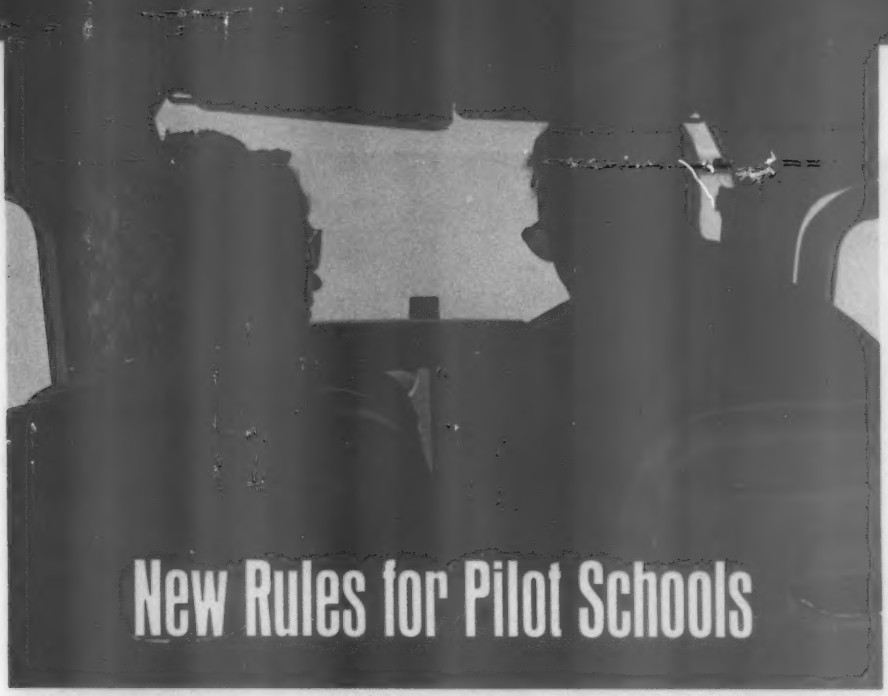


New Rules for Pilot Schools

FAA proposes FAR Part 141 changes to match new pilot certification rules

Proposed changes to FAR Part 141, certification of pilot schools, would place a greater responsibility upon the school for enabling trainees to achieve new ratings within a predictable period of instruction. There would also be an upgrading of the standards for training facilities, instructors and school curricula.

An FAA-certificated school is one whose training courses have been approved by the local general aviation district office. Some 2,300 FAA-approved pilot schools which currently employ about 7,000 of the nation's 35,000 flight instructors would be affected.

The proposal would require each flying course at an approved school to include prescribed ground instruction correlated with flight operations. Each course outline and curriculum would be tailored to the facilities, locale, staff and aircraft used by the school. Access to a runway at least 2,600 feet long and 50 feet wide would have to be provided. Each student, upon his enrollment, would receive a complete course outline enabling him to evaluate his own progress and anticipate training to be completed.

Under the proposal all existing certificated pilot schools would be given a reasonable length of time in which to be converted to one of two new categories:

1. **A fully certificated school.** To qualify, the school must have trained at least 20 students during the preceding 24 months. Eight of the ten most recent graduates who took tests from FAA inspectors or designated examiners must have passed on the first try. Certificates would be renewable every two years, if the school met the prescribed standards for training activity and quality of instruction.

2. **Provisional certificates.** A pilot school which did not meet the criteria above could be issued a provisional certificate good for two years. If the school failed to meet the new training criteria during that period, the certificate would lapse, and the school could not re-apply for at least one year.

Additionally, fully certificated pilot schools could apply for an *examining authority*. This would entitle them to recommend graduates for an appropriate pilot certificate or rating without having to pass a flight or written test given by an FAA inspector or designated examiner. To be eligible, pilot schools must have been fully certificated for at least two years and not have incurred any violations involving their pilot training over the past three years. They would also need to have trained at least 20 students during the preceding two years, of whom nine of the most recent ten had passed their tests on the first try.

The present regulation requires schools to maintain an 8-out-of-10 passing record, but a school can evade this by not graduating its poorer students. Under the new rule, all students must be formally enrolled, and a minimum of approved course training activity is required for the biennial renewal of school certification.

The proposed rule changes would increase the advantages of attending a certificated pilot school. Not only would the airman be assured of a greater likelihood of passing his examinations on the first try (or of bypassing this requirement), but he would also have an opportunity to reduce the number of hours of flight time required for his new rating or certificate. For example, the recently amended rules concerning the private pilot certificate call for a minimum of 20 hours of solo flight time. At a certificated school he might be able to qualify with only 15 hours of solo time.

Similarly, the minimum of 40 hours of total flight instruction required for the private pilot certificate may be reduced to 35 during attendance at an approved school. The minimum of 250 hours of flight time as pilot required under the new regulations governing the commerical pilot certificate may be reduced to 190. Total cross-country time may be shaved from 50 hours to 40 hours.

This reduction in flight time is made possible by a program of instruction which calls for much greater instructor surveillance over his student, including mandatory pre-flight briefings and post-flight reviews. This practice reduces the possibility of accidents during training on the one hand, and increases the value of flight experience on the other. There would also be stage tests when each phase of training was completed.

The school would be obliged to maintain each student's training records for at least one year after graduation. In the event that the airman developed any problems with his flying after graduation, it would be possible to study the record for indications of weakness in the training program. To assure a continuity of training, a student would be required to complete certain courses within a given time limit: for the private pilot, 12 months; commerical pilot, 24 months; instrument rating, 6 months.

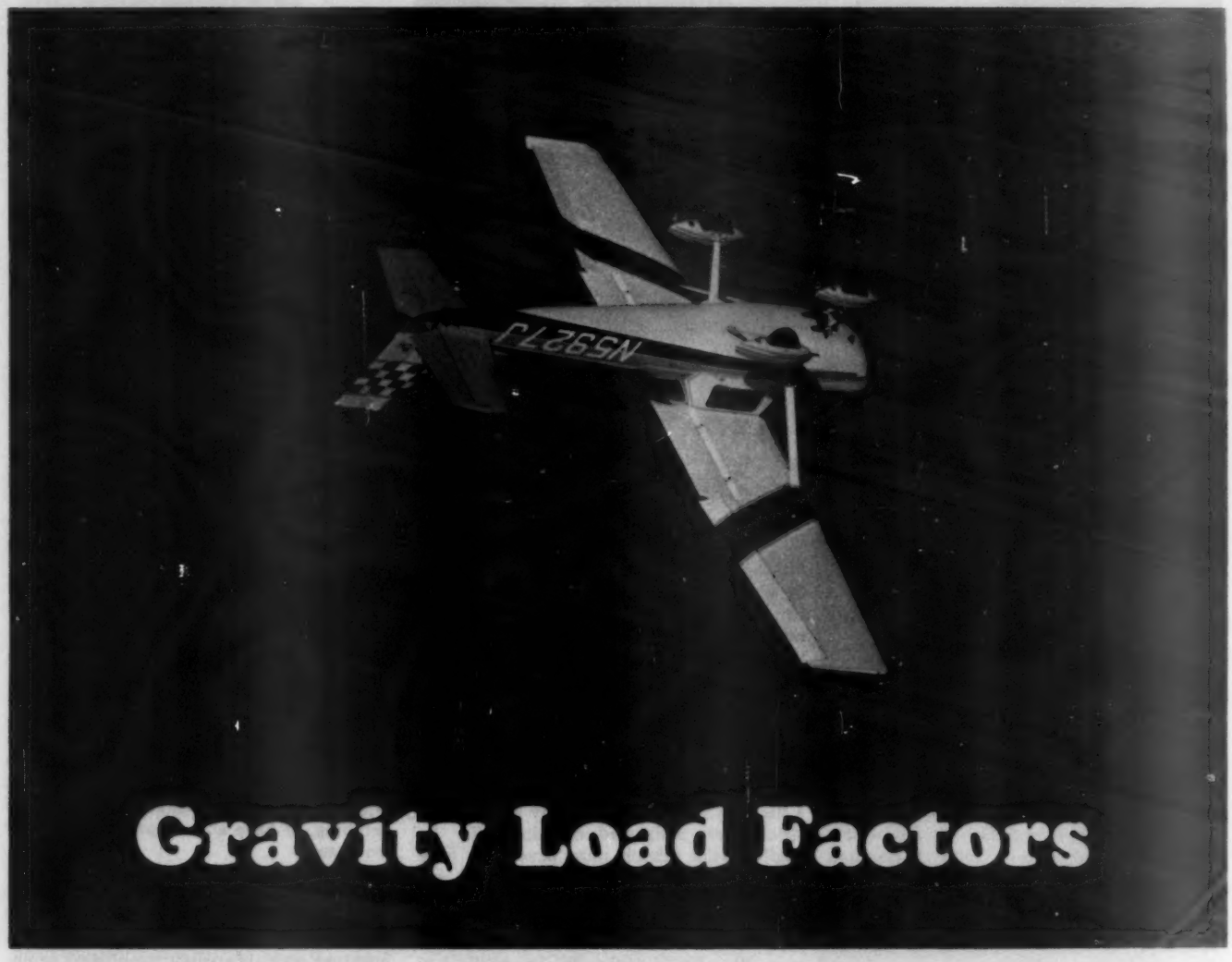
The majority of the students attending certificated schools would be taking a complete course. However there are some abbreviated or "test" courses to accommodate students who have already accumulated much of their required flight time before enrolling, or have already passed their written exams.

For example, the full "Private Pilot Certification Course" includes 35 hours of classroom instruction and 35 hours of flight training, but a student with 30 or more hours of pilot time would be eligible to enroll in the shortened "Private Pilot Test Course" which requires only 12 hours of flight training. He would, however, have to take the full 35 hours of classroom study, unless he had previously passed his FAA written examination.

There are shortened test courses for private and commercial pilots, and there are complete certification or rating courses for private, commercial, instrument, flight instructor, airline transport pilot, rotorcraft, glider, and all the other airman certificates and ratings issued by FAA. The course outlines must be approved by the local FAA GADO.

The complete proposal concerning changes to Part 141 was published in the Federal Register on February 9, 1973, and is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The price is 20 cents.

Comments on the proposal, Notice #73-5, are invited. They should be sent before May 10, 1973, to FAA, AGC-24, Washington, D.C. 20591. ■



Gravity Load Factors

How many G's can your airplane stand?

The *load factor* capability of an airplane is a consideration of special importance to the designer of a new aircraft, because it influences the strength and general performance of the plane. It is also important to the pilot, because it helps him understand how much stress and strain his aircraft will endure safely under various conditions of flight.

The designer's *load factor* is not to be confused with an identical term employed in airline operation. To the airline traffic manager it means the percentage of seats filled on a given flight. The engineering term *load factor* is something quite different. By definition, it is "the sum of the vertical forces acting upon the airplane relative to the force of gravity." In other words, it is the relative magnitude of gravity, as compared to the aircraft's vertical lift. *Load factor* is expressed in terms of gravitational units, or "g's". Whenever an aircraft flies in such a manner as to exceed its load factor limit, it may be overstressed and possibly suffer structural failure.

When an airplane is flying straight and level, there are two forces pertinent to *load factor* acting upon the airplane—vertical lift and gravity. Vertical lift in this instance is equal to the force of gravity (the weight of the airplane), so the flight *load factor* is one g.

In most maneuvers, such as a change in attitude or a banked turn, the third major force—centrifugal force—enters the picture. The addition of centrifugal force brings about change in load factor. For example, a level turn at a bank angle of 30 degrees increases the load factor to 1.15 g's; at 60 degrees it goes up to 2 g's.

FAA airworthiness rules specify the minimum allowable load factors. For normal category aircraft, the requirement is a load factor ranging from 3.17 to 3.8 g's, depending upon the weight of the airplane. For utility aircraft—such as training planes required to perform spins, chandelles or similar maneuvers—the minimum is 4.4 g's and for aerobatic aircraft it is 6 g's. Transport aircraft, where maneuvering is normally gentle, are required to meet a 2.5 g minimum.

Today's specified minimums are lower than they were in earlier days. It was once the custom to design for fairly high load factors as a safety bonus. However, design experience showed that this was an excessive precaution; it involved hauling around a lot of extra structural weight—more protection than was needed in the case of the most violent maneuvers a given airplane might be expected to encounter. Flight load factor requirements were lowered accordingly.

In addition to flight maneuver load factor, there is another load factor the pilot must remember—the *gust load factor*. After taking into consideration every practicable condition of maneuver, the design standards

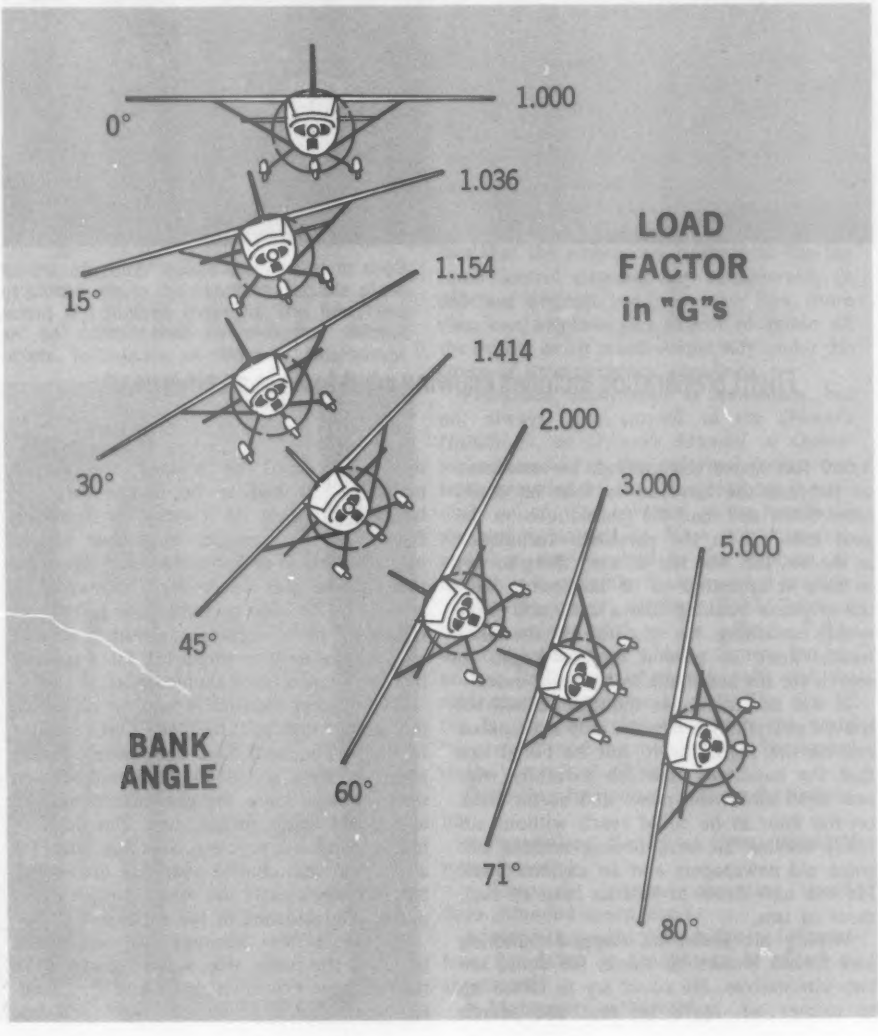
allow for the turbulence of the atmosphere. For instance, a sharp updraft of air, frequently experienced in thunderstorms, imposes an additional force on the airplane above and beyond normal flight loads. FAA airworthiness rules also specify minimum requirements in this area.

Guarding against the possibility of a pilot's exceeding the specified load factor limit, aircraft designers are required to provide a margin of safety, so that the *ultimate load* is generally well above the prescribed minimum. A jetliner, required to meet a 2.5 g minimum, must be designed for a 3.75 g ultimate load factor at design maximum weight.

Nonetheless, accidents can and do occur as a result of exceeding load limitations. A prime example in general aviation is the "graveyard spiral" that may be encountered when a non-instrument rated pilot stumbles into instrument weather conditions. In his disorientation, he permits the plane to fall into a diving turn. The plane picks up speed rapidly. The pilot notices the increasing airspeed and decreasing altitude and attempts to pull back on the wheel, but by this time the dive angle is so steep and the airspeed so high he could literally pull the wings off trying to recover.

The combination of maneuvering load factor and gust load factor is another potential source of trouble. Consider an airplane tightly banked in a thunderstorm, a practice which is devoutly to be avoided but which may occur on occasion. Say the bank is 60 degrees. The maneuvering load factor is 2 g's, well within safe limits. But suppose the airplane is subjected to a sudden powerful thunderstorm updraft while it is in that steep bank. This updraft imposes an additional load factor on top of the maneuvering load factor, perhaps doubles it, and the total stress may exceed the airplane's design limitations.

Changing load factor can also bring about an unexpected stall during maneuvers, because an airplane's stall speed goes up with an increase in load factor. For example, a typical light twin has a stalling speed of 85.5 knots in level flight. But in a 45 degree bank the same airplane will stall at 102 knots and in steeper turns the speed is still higher.



Excessive weight on an airplane can be a trouble source with respect to structural stresses. An airplane loaded beyond its maximum gross weight may experience structural damage when the maneuvering load factor is well within safe limits for a normally weighted airplane.

High load factors can be hazardous even when no structural damage to the airplane is involved, because they influence the human body as well as the aircraft. Take the case of a pilot in an aerobatic plane or a supersonic military fighter, both of which usually have design load factors of more than 7 g's. In a violent maneuver, the pilot may experience a force of 4 or 5 g's. This will not bother the airplane, built to take considerably more. But if the pilot is not wearing the protective gravity suit, the forces of acceleration may cause the blood to drain from his brain, inducing blackout and loss of control of the airplane. (The G-suit restrains the flow of blood away from the brain.)

In such aircraft and certain others, the instrument array includes an accelerometer to advise the pilot of changes in load factor. The lightplane pilot is not likely to have such sophisticated instrumentation. His awareness of increasing load factor is physical. He will experience a general sensation of heaviness, because, at anything above one g, he is literally heavier than he would be on earth. As load factor builds, he will find it harder to hold up his arms and manipulate the controls; he will feel the extra pull of gravity on his legs and on his body generally. Hence, the conviction of many old-timer pilots that they flew "by the seat of their pants" was not a fiction. Pilots with few or no instruments learned to sense directional change in the aircraft by the sensation of being "glued to the seat."

Structural damage from higher-than-allowable load factors need not be catastrophic, of course. It may in fact be cumulative. The pilot who feels he may have exceeded the design limit should take a close look at his airplane after landing. If there is any bent surface, skin-wrinkling, rivet-popping or any evidence of deformation, he should have a competent mechanic give the plane a more detailed inspection. If the damage is uncorrected, the weakened structure may fail on a later flight on a maneuver that would otherwise be routine.

Every pilot should familiarize himself with the load factor performance curve of his particular airplane. Details will be found in the airplane's flight manual. If there is no flight manual, or the airplane is not appropriately placarded, consult the manufacturer. The airspeed redline range is only one of the limitation warning signs: you need to know them all to fly safely. ■

Preflight in Haste . . . Repair at Leisure

A Word in Hand

Flight preparation includes knowing what to do in an emergency.

General aviation aircraft are so well constructed these days that you can fly one for years and years without ever having any kind of inflight emergency. But the possibility of such an emergency is always present in every flight, from the moment of departure to the point of shutdown, and if it does happen to you your chances of coping with the problem successfully may depend not merely upon your flying skill and coolheadedness, but also upon the accessibility of emergency information. Consider the following incident:

A construction engineer who had been flying for 20 years, the last ten in his own *Comanche*, without ever having so much as bent metal, had to make a trip some 300 miles down state in California one day when his own airplane was in the shop for an annual inspection. He rented an aircraft, also a *Comanche*, since he preferred to fly something he knew inside and out, took off on a beautiful spring morning, and came in sight of his destination two hours later. Approaching the pattern he flipped the toggle switch that activated the gear, and that is when his trouble began. The flight had been uneventful, except for a moderate amount of turbulence that had spilled out the contents of his flight case at one point, and the rented *Comanche* performed much like his own.

The gear motor groaned, as though it were going into action, then stopped. The pilot tried recycling the switch several times, but the gear motor was definitely dead. He had nearly an hour's fuel remaining, but the red light on the panel was urging him to take some appropriate action.

Although he had never lowered the gear on his *Comanche* manually (they had just had him go through the motions on his checkout, those many years ago) he knew that the motor had to be disengaged, somehow, before the manual handle was thrust forward—and he recalled the instructions were on the inside of the lid covering the gear motor access box, between the seats. He flipped it open. The instructions were there, all right, but he was surprised to find that they had apparently faded somewhat with time, and difficult for him to read.

After an exasperating moment of trying to adjust his bifocals to a readable distance, he decided that burying his head in the cockpit this close in to the airport pattern was not a good idea, so he announced on the UNICOM frequency that he was leaving the area, and did so cautiously.

Several miles away from the airport, at 3,000 feet above the ground, he attempted to stabilize the airplane so that he could bend down and read the instructions on the gear box. Given the persistent turbulence in the air, this was not an easy thing to do; in fact, it appeared to be impossible with the airplane bucking like a colt, and after nearly smashing his glasses on the gear handle knob he gave it up and began to search for his handbook in his flight case.

It was not there. He thought he had retrieved everything when the case had spilled out on the flight down, but he could not find the handbook. He felt carefully with one hand under the panel and as far back on the floor as he could reach without actually leaving his seat, finding nothing but some old newspapers and an ancient chart. He was now down to half an hour of fuel, more or less.

Wiping his brow, he stopped fumbling and forced himself to think. He could see two alternatives. He could try to climb up to calmer air, leave his seat and search thoroughly until he located the elusive handbook. It had to be in the airplane, because he never let it stray far from his flight case. Or, maybe, in calmer air he might be able to decipher the printed instructions on the gear box cover. Or, maybe, he would *not* be able to outfly the turbulence within 10 or 15 minutes, in which case he would have to start preparing for a gear-up landing—and a lot of explanations.

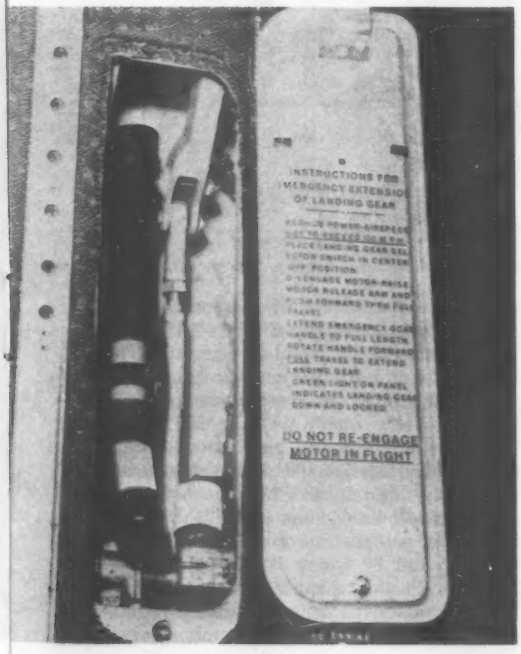
The second alternative was to return to the airport and ask the UNICOM operator for help. The local fixed-base people would probably have a *Comanche* handbook, or someone who knew the gear extension drill, and could radio instructions. The idea of blurting out his problem over the horn for all to hear and chortle over was distasteful, but this was clearly the more sensible alternative. He returned to the pattern.

Within a few minutes he was being led, over the radio, step by step through the manual gear extension procedure . . . *landing gear switch in center "off" position,*

The time to take inventory of essential flying data—including emergency procedures—is before takeoff. Pilot at left has clipped his flight manual where he can reach it immediately.

disengage electric motor by pushing motor release arm forward through full travel, pull out emergency extension handle to full length . . . etc. The wheels came down easily, and the landing was routine. The only damage was to the pilot's pride.

The manufacturer makes every effort to spell out procedures in the handiest possible place (below) but reading them for the first time can be complicated by darkness, bifocal glasses, turbulence, or stress of emergency.



But the lesson he learned was valuable: when it comes to emergency instructions, a word in hand is worth a thousand "somewhere in the airplane." All placarded information must be clearly and legibly available to the pilot at all times and noting its presence and condition should be a regular item on the pre-flight check. In view of the fact that the emergency procedures for the same control element vary considerably in different aircraft, no one who flies more than one airplane can expect to retain all the details in his mind—especially under the stress of an emergency situation.

Placarded information is sometimes, but not always, also carried in the *Owner's Handbook*, or *Owner's Manual* or *Operator's Manual*, as the informal instruction book provided by the manufacturer is variously called. The contents of the handbook are not submitted to FAA for approval, and it is not required in the airplane, although it is certainly recommended reading.

The *Approved Airplane Flight Manual* on the other hand, is an official, FAA-approved document which contains the operating limitations of the aircraft, and the emergency procedures as well. The title of the booklet will always contain the word "approved" and the manual must be carried in the aircraft at all times.

Operating limitations include the following:

- Powerplant (limits on rpm, manifold pressure, etc.)
- Airspeeds (normal operating speed, flaps extended speed, etc.)
- Aircraft weight and balance information (up-dated as equipment is added or subtracted)
- Maneuvers authorized
- Minimum flight crew required (if more than one)
- Kinds of operation allowed in the aircraft (VFR, IFR, night)
- Maximum operating altitude (applies to pressurized aircraft, which must have extra-strength windows above 25,000 ft.)
- Maneuvering flight load factors (positive limit load factors in g's)
- Maximum passenger seating capacity.

Before 1953 all aircraft, regardless of weight, were required by regulations to have these items included in a Flight Manual. Since then the manual has been required only for planes heavier than 6,000 lbs., and manufacturers of lighter planes have had a choice either of compiling a Flight Manual or of providing the limitations in some other form (placarding).

In the case of our construction engineer in the *Comanche*, it so happens that this airplane has an Approved Flight Manual (probably residing in the seatback pocket behind the pilot). Thus the desired information is actually given in three different places (inside gear motor lid, handbook and Flight Manual)—which underscores the importance of knowing where to find what you need when you need it—fast.

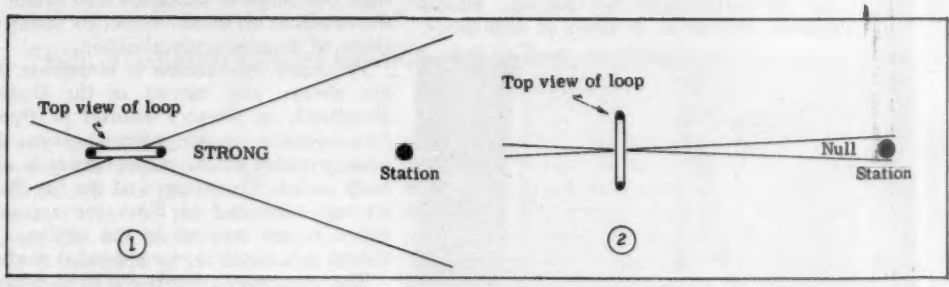
Partial listing of light (under 6,000 lbs.) aircraft which do have Approved Flight Manuals:

Aero Commander: B-1, 100, 200, 320, 500, 560, 560F, 600, 680, 681, 690, 695, 720.
Aeronca: 11-C.
Beech: 35, 34, H-35 thru 35-33A, 50, 95-55.
Bellanca: 14-19, 17-30, 31-42.
Cessna: 120, 140, 170, 180, 190, 195, 305.
Champion: 402.
Helio: 250, 295, 391, 395, 500, 550, 550A.
Luscombe: 11-A.
Lake: C-1, LA4.
Maule: M-4.
Mooney: 10, 18, 20, 22.
Navion: A, B, D through H.
Piper: All models, except J-3.
Pitts: S2, S2-A.
Stinson: 108.
Taylorcraft: BC-19.

In addition to the "Flight Manual material" there are certain other items for which placards are required. These include fuel and oil filler openings, baggage compartment weight limits, seat limits if they are less than the standard 170 lbs., magnetic compass calibration, cockpit controls, emergency exits and others.

It is the responsibility of you, as the pilot, to be sure that all required data is, indeed, in or on the aircraft, and is quickly accessible. If you are not sure about any piece of information, you can consult the nearest FAA General Aviation District Office, an FAA Approved Aircraft Repair Station, or a mechanic with an FAA Inspection Authorization. ■

Automatic Direction Fi



Despite the wide spread acceptance of VOR as the basic air navigation system in the United States, the old Automatic Direction Finder (ADF), or radio compass, still finds wide use in many types of aircraft. Its principal usage is in general aviation, but it also is carried in military planes and commercial airliners. Although such aircraft have a sophisticated array of navigation devices, the versatility of the ADF makes it valuable as a supplement.

The forebearer of the ADF dates back to the late 1920s soon after the first low frequency-medium frequency radio ranges were installed. The LF-MF range sent a coded aural signal to the pilot's headset. By means of some mental calisthenics and airplane maneuvering, he was able to fly directly over the transmitting station for a position fix. The next step was to provide a more positive indication of the relative positions of airplane and transmitter.

This was accomplished by virtue of the directional properties of a ring, or "loop" antenna. The loop antenna received signals in varying degrees of intensity depending upon its alignment with respect to the transmitting station. A familiar example would be the miniature commercial broadcast receiver, the "pocket radio", which has circuitry comparable to the aircraft loop antenna. Holding the radio in front of you, rotate yourself through 360 degrees. You will notice that the signal alternately builds up, then fades, as you rotate. The point at which reception is the weakest is the *null position*, or simply *null*. This occurs when the signal is passing through the "hole" in the loop.

The strongest signal, conversely, is when the plane of the loop is in line with the station. For purposes of radio navigation, the null position is more useful, under most conditions, because directionally the null can be defined much more accurately than the maximum strength signal path. (Modern ADFs have dispensed with the loop antenna and operate on the strong signal.)

In the earliest direction finding systems, a loop antenna was mounted on the airplane in line with the wing. The pilot, listening to the signals on his headset, would turn the airplane until he found the null; this meant that the airplane was now flying in line with the radio beam.

To do away with the need for turning the airplane to line it up with the signal, a change was made from a fixed to a rotating antenna, used in conjunction with a bearing indicator. The pilot rotated the antenna by turning a handle in the cockpit until he found the null. The bearing indicator then showed the number of degrees the pilot would have to turn to align his airplane with the radio beam.

One problem with this equipment was that when he was on the beam, the pilot could not be certain whether he was flying toward or away from the station. The next evolutionary step was the addition of a specially designed second antenna, called the *sense antenna*, which provided the directional information.

The final step was to add the automatic feature to the ADF. The loop antenna was provided with a small electric motor. When the pilot tuned to the station, the signal received energized circuits which rotated the motor and turned the loop antenna until it found the null, where it automatically stopped.

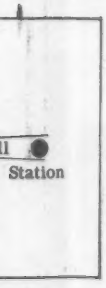
Thus, the ADF indicator, or radio compass, always shows the bearing *from the aircraft to the station*. The pilot can plot this information in various ways. If the radio signal is emanating from the vicinity of his destination airport, or near an airport he can make use of, he merely turns his airplane until the needle on the ADF instrument panel points to zero and keeps it there. If he overflies the station, the needle will swing around 180°.

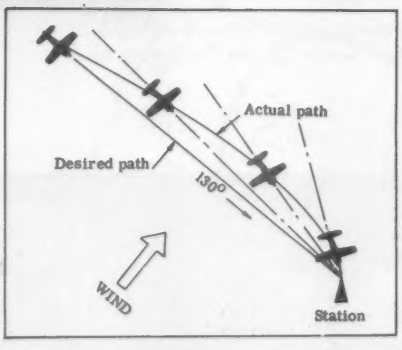
Alternately he can use his ADF to establish a line of position from two or more stations, and by triangulation establish his position. In this manner he can navigate across country, as long as weather conditions are VFR. If his destination airport

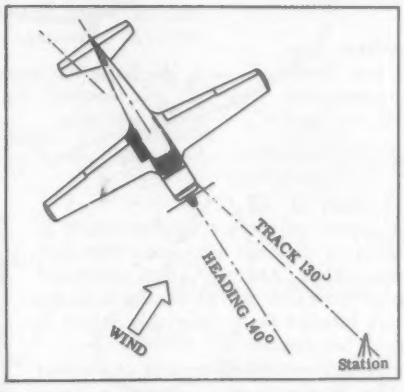
Finders

The trusty "Bird Dog" still points the way for many pilots.

Above—typical Automatic Direction Finder, a multi-purpose instrument that can home in on aviation beacons and commercial radio stations alike, and is helpful for cross-country navigation and IFR approaches. Below far left—diagram shows why the null signal is more accurate than the peak signal for tracking. Below—a pilot who fails to correct for a crosswind will fly a curved path to the station; with the proper crab angle he tracks in a straight line.







has a compass locater beacon he can home in on it to make his approach.

The components of the modern ADF system include:

• **The ground stations.** ADF's versatility stems from the fact that it can utilize the signals from any low-medium frequency transmitter—LF-MF ranges, nondirectional radio beacons and even commercial broadcast stations, making available literally thousands of homing sources. Some of today's instruments offer a range of from 190 to 1750 kilohertz.

• **The antennas.** The basic antennas (in the older sets) are the loop antenna and the sense antenna, both receiving signals from the same station. The two signals are electronically compared to define a single null position, so that the bearing indicator points only *to* the radio station.

• **The receiver.** The "black box" contains electrical circuitry which digests the information from the antennas and translates it into movement of the needle on the bearing indicator dial.

• **The cockpit display.** This includes a band selector, frequency dial, the control unit and a bearing indicator. On the compass rose of the bearing indicator, zero represents the direction in which the airplane's nose is pointing. The indicator needle always points to the bearing of the station relative to aircraft heading (unless a manual control unit is in use).

The ADF is not as precise as the VOR system and there are disadvantages associated with the fact that it operates in the lower frequencies. Because VOR uses the Very High Frequency portion of the radio frequency spectrum, it is relatively free of interference; the ADF, in the LF-MF bands, is subject to static, and in thunderstorms or other atmospheric disturbances the bearing indicator may become erratic or the signal may be lost altogether.

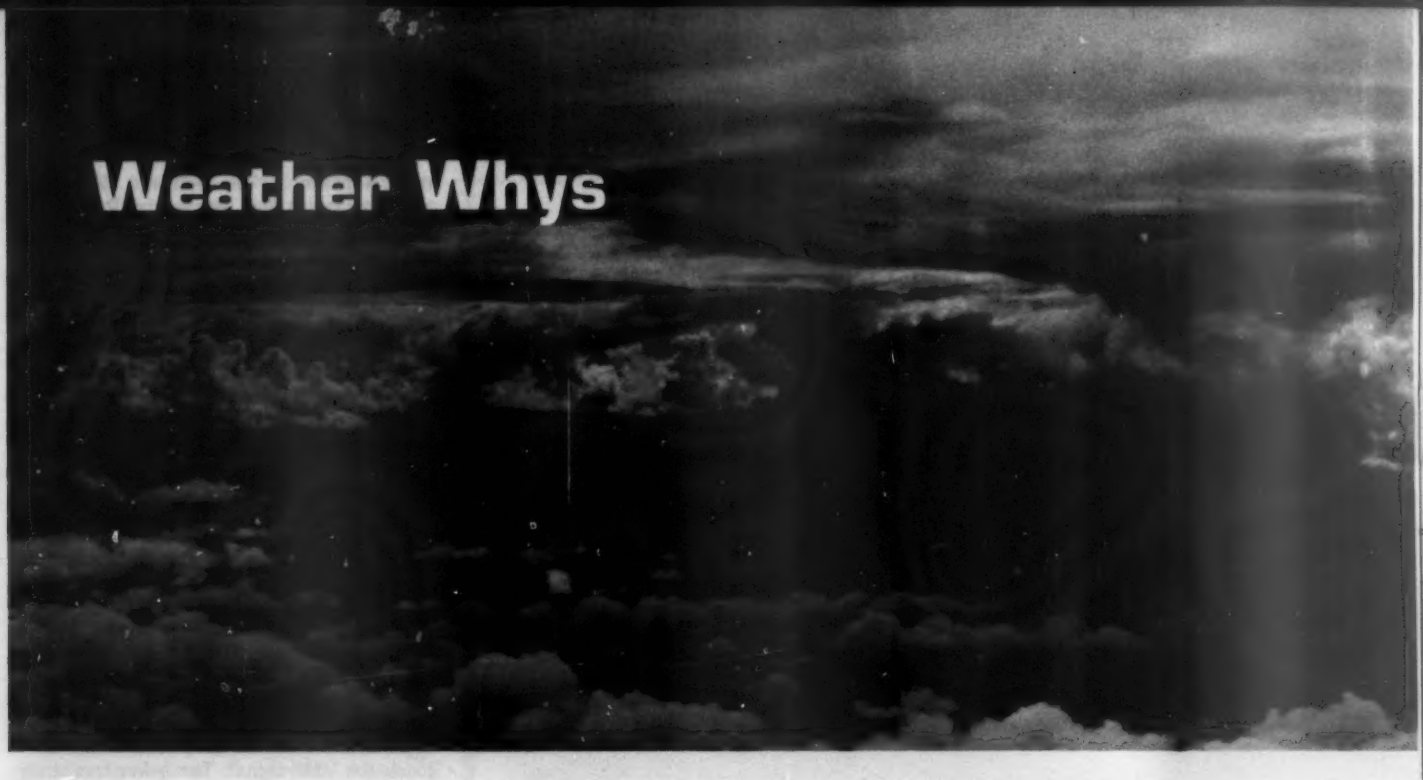
However, operation in the lower frequencies can also have advantages under certain circumstances. The VOR is essentially a short-range system while the ADF, when atmospheric conditions are right, has a greater range capability covering hundreds of miles. VOR is also a line-of-sight system, a factor which poses no problem under most flight conditions, but in low-altitude flight in mountainous areas the terrain may block the VHF signal. The lower frequency radio waves used by ADF fan upward from ground level and tend to hug the ground contours in hilly country.

In some parts of the world, the ADF is still a primary navigation system but for the most part it has become a supplement to the VOR. Neither the VOR nor the ADF —by themselves—provide definite position fixes, except when flying directly over a transmitter. Each gives a bearing, which can be plotted as a line of position. Because they use two different radios, an operator can take simultaneous VOR and ADF bearings, plot them and note his position at the common point where they intersect.

One could, of course, use the VOR alone to take bearings from two different stations, but they would not be simultaneous and there are times when there is only one VOR station available. Similarly, the ADF, used as a back-up to the VOR, can at times take over the primary navigation job—for example, in the areas where the VOR transmitters are too far apart, are blocked out, or nonfunctioning.

A typical modern ADF package—receiver, control unit and bearing indicator—costs in the vicinity of $900, to which must be added the price of the antennas, as these vary widely. The system is relatively simple and maintenance is correspondingly trouble free.

There is little current emphasis on further development of this instrument, which had its period of greatest utility in the pre-World War II period. But the ADF still has its devotees who swear by it—and occasionally at it. Automatic Direction Finders are still being produced by several well-known avionics manufacturers and they are likely to be around for a long time to come. ■



Weather Whys

Highs and lows, and how the wind blows.

This article is the first in a monthly series on a subject about which there is considerable ignorance and occasional profanity. Year after year weather has caused problems for pilots; year after year it continues to be a major cause of accidents.

As the performance characteristics of airplanes continue to improve, with pilots flying higher and faster and ranging more widely, they are encountering more and more varied weather conditions. Consequently, the need for weather information—and the ability to use this information properly—becomes more critical.

Weather information is being made increasingly available to pilots, but only weather-educated airmen can take full advantage of the data.

We hope that these articles, written by meteorologists of the National Weather Service at the invitation of FAA, will help.

What is the weather?

It is many things to people as diverse as the farmer, commuter, picnicker or Little Leaguer.

When a pilot asks a forecaster, "What is the weather?", the answers could mean the difference between a safe flight or a disastrous one. To the pilot, weather is any atmospheric condition that can cause him trouble in flight. To the VFR pilot especially, it means low clouds, fog, dust, smoke, precipitation or haze which reduce the distance of the horizon and thus vitally affect his flight.

To the meteorologist, weather is the state of the atmosphere and its short-term variations.

But weather is more than that—it is the cause of 35 percent of the fatal accidents involving light aircraft.

However you define it, weather is governed largely by the movement of great masses of air with different properties of temperature, moisture and wind. These air masses appear on surface weather charts as *highs* because they are associated with high pressure centers. Areas in which maximum mixing of these different air masses is taking place are labelled *lows*, since this occurs in centers of low pressure.

The greatly simplified versions of weather maps that appear on television and in newspapers are based upon charts produced by National Weather Service offices, from information gathered by observations all over the world taken by means of rockets, radar, satellites and more conventional instruments.

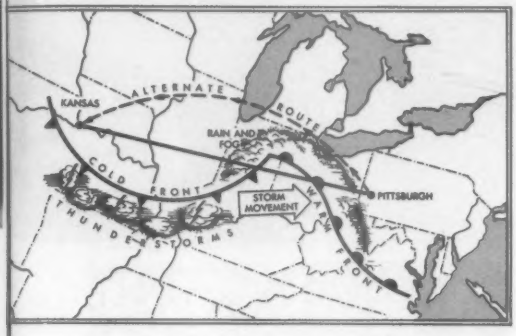
A weather map contains lines called isobars, which are drawn connecting the points of equal barometic pressure. The isobars outline the highs and lows and reveal pressure patterns. Lines on the maps separating different air masses are called *fronts*. Together with highs and lows, the fronts are the outstanding features of the map.

Highs are areas where the barometric pressure is relatively high. In the Northern Hemisphere, winds in a high pressure system flow spirally outward from the center in a clockwise direction. Although a high-pressure system usually brings fair weather, it may be accompanied by cloudiness or precipitation on its outer edges. Highs moving down from Canada have turbulence and gusty surface winds.

FSS briefer is trained to gather weather data from maps and reports and interpret to pilots.

Lows, or areas of low barometric pressure in the Northern Hemisphere, have winds flowing spirally toward the center in a counterclockwise direction. The approach and passage of a low pressure system frequently is attended by bad weather, including cloudiness, storms, or shifting winds.

A pilot flying into a high pressure area without changing his altimeter setting will be higher than the instrument indicates. Conversely, a pilot flying into a low pressure area will be lower than his altimeter indicates.



The general movement of weather in the middle latitudes is from west to east with the pressure systems and fronts being carried along and showing a progressive day-to-day eastward movement. When this general circulation brings air masses with distinctly different properties in contact with one another, they refuse to mix freely and a front is born.

A cold front is the leading edge of a cold air mass advancing into an area occupied by warmer air. It appears on the weather map as a line with triangular symbols pointing in the direction of the front's movement.

A warm front is one in which the warm air replaces relatively cold air. It is shown on the map as a heavy line with semicircular symbols on the side toward which the front is moving. Warm fronts generally move at slightly less than half the speed of cold fronts.

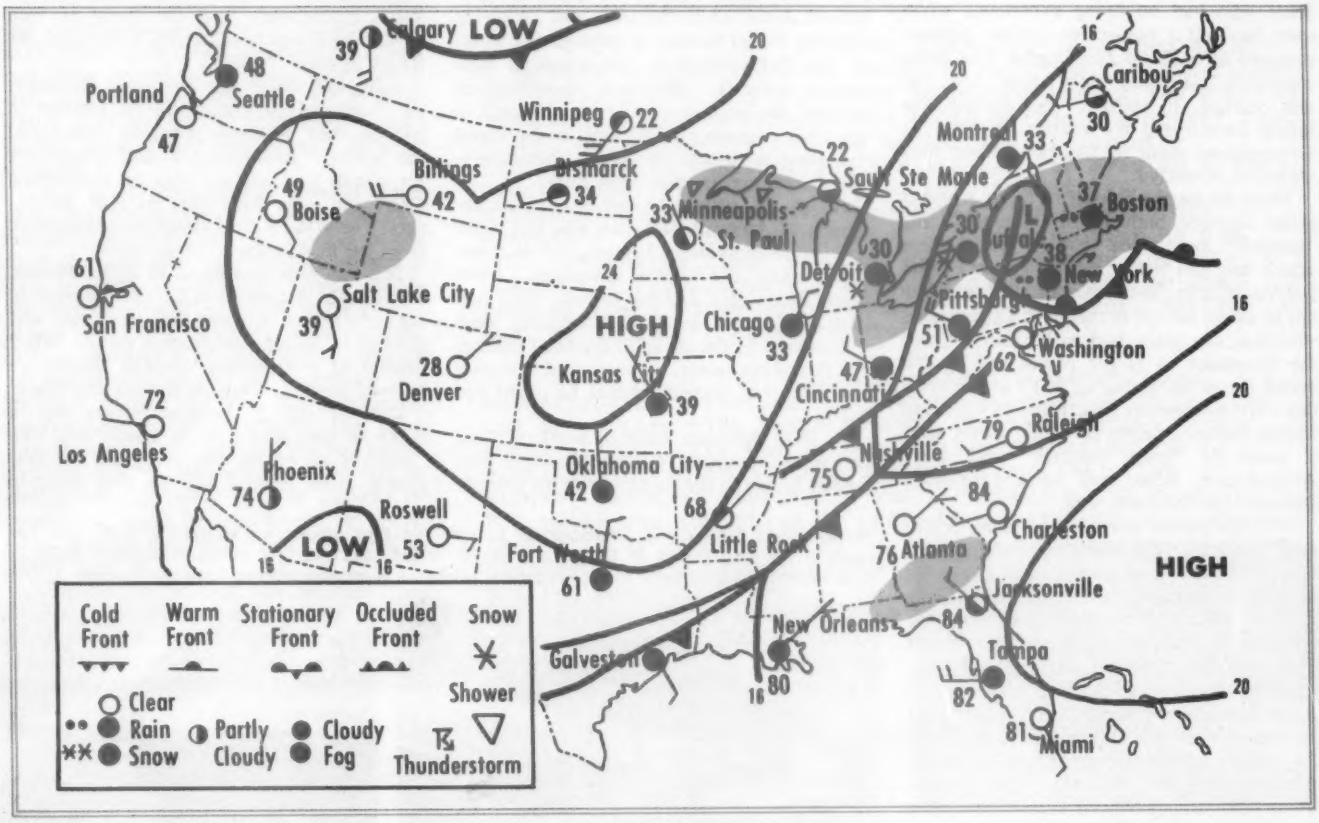
Most of the substantial changes in weather occur in the areas where two air masses meet. In general, the greater the difference in temperature between two air masses, the more vigorous the weather distribution will be. When warm air meets colder air, the lighter warm air must flow over the cold. As it rises and cools, its moisture may condense, forming clouds and rain or snow.

Fronts may bring little weather activity or they may mean severe disturbances, depending primarily upon the contrast in temperature and moisture between the cold and warm air of the two masses. The zone of weather activity associated with a cold front normally is narrow with corresponding rapid changes. In contrast, the area of activity associated with a warm front is broad with a gradual change of weather both in time and distance. Either frontal system can create hazards to flying.

The weather map on television or in the newspaper, and the forecast by a commercial radio station, can assist a pilot in knowing his weather. However, before any airman takes off he will be doing himself a great service to get a more definitive weather briefing—either from the FAA Flight Service Station or the National Weather Service office.

Next month—Cold Fronts

By proper use of weather reports (below) and forecasts a pilot can plan an alternate route (left) to avoid bad weather. Caution: weather map shows past conditions rather than present.



Famous
Flyers

The Buoyant Bellanca

In the last decade of the 19th century a small boy played along the high Sicilian cliffs overlooking the blue Mediterranean. Frail and highly imaginative, he loved to "touch the wind" as it swept up over the cliffs and he spent hours flying kites in the strong updrafts. He was fascinated by the sight of seagulls riding on the wind, and he learned to spin discs of potter's clay out over the turbulent air, much as other children would spin flat rocks over a pond. In time, his youthful love affair with the wind was to lead him into a remarkable career in the field of aeronautical design; and aircraft bearing his name would conquer the skies.

Giuseppe Mario Bellanca was born in 1886 in Sciacca, in Sicily. He was schooled in Milan in mathematics and engineering, and as a student wrote about the new field of flying for French and Italian technical publications. In 1908, with two other students who had no flying experience whatever, he built a two-seater, pusher biplane, powered by a 20 hp *Zust* engine. The plane eventually staggered aloft about 100 feet and crashed. In spite of this mishap, his family encouraged his interest. In 1912 he accompanied them to America, where they settled in Brooklyn.

There he taught himself to fly in a homemade airplane built in his basement. His "parasol" monoplane had a pilot's seat which was just below the wing and behind a three-cylinder 30-hp. Anzani "Y" that was apt to squirt hot oil at the pilot. During construction, the plane had to be moved from the basement to larger places and finally ended up in the spring of 1913 at the Garden City Aerodrome near Mineola on Long Island. Bellanca began his flying career with a series of "grass cuttings" and short straight-away hops, and soon considered himself a professional pilot.

With the public interest in aviation beginning to emerge, Bellanca opened a flying school in 1914. One of his most illustrious pupils was Fiorello La Guardia, the "Little Flower" who was to command an aero squadron in Italy during World War I and to become one of New York's great mayors.

At the same time, Bellanca continued to design new aircraft, and in 1916 he attracted the attention of the Maryland Pressed Steel Co., which was becoming interested in the manufacturing of airplanes. The Hagerstown, Md., firm produced a prototype of a Bellanca design and half a dozen partially completed airframes before going into bankruptcy in 1920.

Not discouraged, Bellanca immediately designed a new "commercial type" aircraft. Four passengers seats were positioned in an enclosed cabin, with an open cockpit for the pilot. Backers for this first cabin aircraft to be built in the United States were difficult to come by. Bellanca was lured to Nebraska by a group known as the Omaha Aircraft Company, who put up $7,000. The Bellanca "CF" was later financed to completion by two other Nebraskans, Victor Roos and A. H. Fetters.

Test flown in 1922, the "CF" demonstrated many of the new ideas in aerodynamics which were to make Bellanca famous. These included a high lift/low drag airfoil, sometimes known as the "M" design, which gave the little airplane unusual climb capacity—it could reach 5,000 feet in ten minutes, an amazing performance for its time. The "CF" entered three major flying meets in 1922 and swept to victory over every plane in its class, including Walter Beech's highly efficient Laird *Swallow*.

Despite its quickly acquired praise as "the world's best airplane" the Bellanca CF did not sell. With the airplane market glutted with WW I surplus *Jennies, Standards* and *DeHavillands* selling for a few hundred dollars, a $5,000 Bellanca CF found no takers. His aircraft factory at Council Bluffs burned down while Bellanca was dickering with the Postal Service to redesign the wings of the DeHavilland 4, the standard mail service aircraft. (Bellanca modifications reduced the landing speed from 60 mph to 40, while retaining a 107 mph cruise speed —a great advantage for night operations). The designer returned to New York.

At age 38, after 12 years of aircraft designing in America, Bellanca was still without a solid reputation. His original backers, chiefly restaurant owners, cooks and waiters from Brooklyn's Italian colony, still had faith in him, but financial institutions were discouraged by the string of financial failures that dotted his career. He continued to dream and plan, but without capital he could not build.

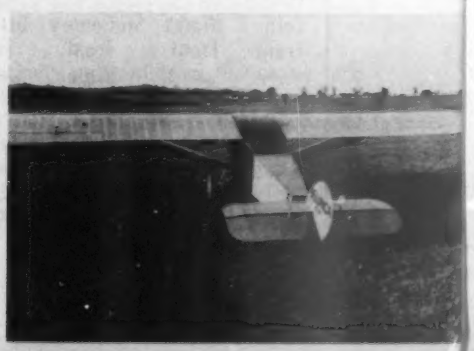
In 1924 Bellanca went to work for the Wright Aeronautical Corporation and proceeded to design the prototype of an aircraft that was to dominate the field of long distance flight for nearly a decade. The WB-1, first flown in September, 1925, was a four-to-six passenger monoplane with a 200 hp engine and a modern appearance, including a fully enclosed cabin. Designed primarily for endurance and economy of payload, the WB-1 nevertheless won the speed as well as efficiency events at the 1925 National Air Races in New York.

Alas, the WB-1 was destroyed following an ill-advised endurance record attempt in bad weather. Bellanca promptly redesigned the aircraft, substituting a steel framework for wood. The payload was an astonishing 1,607 lbs.—the equivalent of nine passengers! The WB-2 simply swept the competition from the field in the 1926 air races.

But bad luck continued to dog Bellanca. The Wright Aeronautical Corporation was in business to sell engines, not airplanes, and refused to go into production on the WB-2 despite its international acclaim. Bellanca's beloved airplane went on the auction block.

One of the prospective buyers was a lanky air mail pilot from St. Louis, who, like others of his breed, was eying the $25,000 Orteig prize offered for the first nonstop

Pioneer flyer Clarence D. Chamberlain bought the first production model DE (left) and became a life-long friend of Bellanca. The DF (right) was the first cabin monoplane built in U.S. Enclosed cabin held four passengers; pilot flew from open cockpit behind the wing.



Above—rear view of first Bellanca aircraft, which flew only a few yards. Giuseppe favored placing the prop in undisturbed air in front of engine, but his two partners insisted on a pusher prop in the Wright flyer style.

flight from New York to Paris. The young Lindbergh was outmaneuvered by a cagey millionaire junk dealer named Charles Levine, who managed to acquire the aircraft for $15,000, hoping to recoup his outlay by winning the Orteig prize with his own pilot. Lindbergh, in turn, outmaneuvered Levine by having an aircraft built specially for him by Ryan in a few short weeks, and hopped off for Paris and immortal fame while the high-powered entrepreneur was still tied up with legal snarls on the ground.

Bellanca, who had been persuaded to enter a business arrangement with Levine, had only the consolation of seeing his beloved aircraft (now named the *Columbia*), set a new endurance record of 51 hours aloft and a new long distance record of 3,911 miles (New York to Berlin), both feats accomplished within a few weeks of the Lindbergh triumph.

Once more Bellanca cast himself loose from financial partners and started his own company. In 1931 his *Miss Veedol*, essentially the same high wing monoplane with a 425 hp Pratt and Whitney engine, made the first nonstop trans-Pacific flight (4,458 miles) with Clyde Pangborn at the controls.

Over the next five years Bellanca aircraft set record after record for endurance and distance, blazing the trail for commerical international air transportation. His company became established as a leading manufacturer, but he continued to specialize in quality aircraft rather than in quantity of production until his retirement in 1954, when he sold out his interests. He died in 1960, aged 74.

Although the present day Bellanca Aircraft Corp. of Alexandria, Minn. has no connection with the family of Giuseppe Mario Bellanca, the reputation for excellence and leadership that he built continues to attract pilots to aircraft bearing his name. The dreams he dreamed as a boy and the lessons he learned from flying his kites and sailing his discs along the cliffs of Sicily helped him show the world how to master the wind.

■ EXPLOSIVES DETECTION in the United States is going to the dogs. A trial program conducted by FAA at Washington National Airport in training dogs and handlers to check out bomb threats and locate explosives was so successful that the program will be expanded to 20 major airports across the nation. The German Shepherd dogs used are trained to identify even faint odors of explosives in different environments, and to alert handlers to their location. Use of dogs is only a small but useful part of the overall security program to prevent bomb extortion or hijacking at airports.

■ EVERYTHING YOU WANT TO KNOW ABOUT PILOT STATISTICS is included in FAA's latest airmen statistics booklet. For example, the total number of all types of pilots rose to 741,009 (although the growth rate remained slow) in 1971, while student pilots decreased in number for the third consecutive year. Active women pilots numbered 31,096, compared to the previous year's total of 29,472. Greatest overall increase was in instrument ratings, up six percent to 179,251.
Copies of "1971 U. S. Civil Airmen Statistics", like other circulars mentioned in this column, are available free from the DOT/FAA Distribution Unit, TAD 484.3, Washington, D.C. 20591.

■ AUTHORIZED EXAM AIDS. Flight computers inscribed with a variety of miscellaneous aviation data are fine in flight, but their use is not permitted by airmen taking FAA written examinations. This information could be used to answer test items, defeating the purpose of testing. A computer inscribed with instructions for its use, or even an electronic calculator if it does no more than solve mathematical problems, is acceptable. Not allowed are computers or devices containing such information as air traffic control light signals, cloud clearance and visibility requirements, FAR's, weight and balance data, etc. AC 60-8, "Aids Authorized for Use by Airman Written Test Applicants", gives further details.

■ AIRCRAFT HOMEBUILDERS are cautioned to investigate advertised construction kits before purchasing, since the use of certain kits could prevent the "homebuilt" from being eligible for amateur-built classification. To be certificated in this class the major portion of an aircraft must be fabricated and assembled by individuals for their own education or recreation. Aircraft assembled from kits of prefabricated components, and pre-cut, predrilled materials, are ineligible. If in doubt, check with the nearest FAA Engineering and Manufacturing or General Aviation District Office, or write for free Advisory Circular 20-28A, "Nationally Advertised Construction Kits, Amateur-Built Aircraft."

Butterfield, Veteran Pilot, is New FAA Administrator

The new face you'll be seeing soon in the left seat of FAA aircraft is that of Alexander P. Butterfield, appointed Administrator of the Federal Aviation Administration last month by President Nixon.

A former Air Force pilot, Mr. Butterfield logged over 7,800 hours in military aircraft and flew with the "Sky Blazers", an Air Force jet aerobatic team. He is a rated command pilot, a qualified parachutist, and a former instructor at the Air Force Academy. He retired with the rank of colonel in 1969 to join the White House staff.

In order to learn some of aviation's problems first-hand the new Administrator is preparing to check out in the FAA *JetStar* and in several other FAA general aviation aircraft.

RNAV Proposed as Basic High Altitude Navigation System

Area navigation (RNAV) would become the primary method of high altitude aircraft navigation in the United States within the next ten years, if the recommendations of an FAA/Industry RNAV Task Force are adopted. Initiation of the program is based to some extent on the success of research and development efforts.

RNAV is an advanced navigation system which utilizes VOR-DME signals but allows variable routing, instead of depending on VOR-to-VOR tracking. RNAV equipment use has increased steadily over the past few years, mostly in air carrier and larger general aviation planes. There are presently about 160 published high-altitude RNAV routes.

The RNAV program calls for a total overhaul of the airspace structure above 18,000 feet, and re-design of high and medium density terminal areas to accommodate RNAV operations in both a horizontal plane (2D) and in a vertical plane (3D). VOR navigation will still be possible in low-altitude airspace since a VOR route structure would be retained as needed below 18,000 ft. It is anticipated, however, that some VOR routes would be realigned for greater compatibility with the RNAV system, and that 3D will go into use at high density terminals, although it will not be mandatory.

Public comments on the RNAV system proposal are invited before May 31, and will be considered in the formulation of a final policy. Address FAA, AAT-500, Washington, D.C. 20591. A limited number of copies of the complete RNAV report are available from the same office.

VSTOL Weather Problems Studied

Low altitude weather problems of vertical and short takeoff and landing (V/STOL) aircraft at STOL-port locations are being studied in Seattle. Eleven especially-equipped towers, ranging up to 160 feet in height, have been set up to observe the effects of wind sheer, turbulence, cloud ceilings and other weather phenomena that must be considered in selecting sites for V/STOL facilities, determining runway directions, developing weather instruments for V/STOL operations and improving aircraft design.

The project is being conducted under an FAA/Atomic Energy Commission interagency agreement.

Offshore Airport Conference Set

A joint government/industry international conference on offshore airport planning will be held near Washington, D.C. from April 20 to May 2. Progress reports on technology and design work for this type of airport of the future will be given by representatives from 16 major cities, including Sydney, Australia; Osaka, Japan; and Copenhagen.

Persons wishing to attend should contact Dr. Jerry Grey, AIAA, American Institute of Aeronautics and Astronautics, 1290 Avenue of the Americas, New York, N.Y. 10019.

EXPERIMENTAL MAGIC CARPET (XMC) is what the engineers are calling this unusual bird. The non-production aircraft was certificated by FAA's Central Region as a flying platform for testing new design ideas for light airplanes. Concepts under evaluation include swept-back wings, rear-mounted engine and shrouded propeller (for improved propulsion and reduced noise).

FLIGHT INSTRUCTOR REFRESHER COURSES

DATE	LOCATION	SPONSOR	TYPE
4/24-26	Denver, Colo.	AOPA & Colo. Flt. Inst. Assoc.	FIA
4/24-26	Richmond, Va.	Virginia Div. of Aero.	FIA
4/24-26	Milwaukee, Wisc.	Wisc. DOT, Div. of Aero.	FII
5/1-3	Kansas City, Mo.	Greater K. C. Chap. 99's	FIA
5/8-10	Sarasota, Fla.	AOPA & Sarasota/Manatee Arpt. Auth.	FIA
5/8-10	Van Nuys, Calif.	Civil Air Patrol	FII
5/15-17	Houston, Tex.	Texas Aero Commission	FII
5/22-24	Charleston, W. Va.	AOPA & W. Va. Avn. Comm.	FIA
5/22-24	Boston, Mass.	Mass. Aero. Comm.	FII
6/5-7	Minneapolis, Minn.	AOPA & NAFI	FII
6/5-7	Oakland, Calif.	AOPA & Alameda College	FIA
6/12-14	State College, Pa.	Pennsylvania State University	FIA
6/12-14	Albany, N.Y.	New York State DOT	FIA
6/19-21	Columbus, Ohio	AOPA & Ohio State University	FII
6/19-22	Norman, Okla.	Oklahoma Aero. Commission	FIA
6/26-28	New Orleans, La.	So. La. Flt. Instr. Assoc.	FIA

FIA—Flight Instructor Airplane
FII—Flight Instructor Instrument
AOPA—Aircraft Owners and Pilots Assn.
NAFI—National Assn. of Flight Instructors

Please contact sponsor for confirmation and enrollment information.

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

• Seaplane Pilots Unite

We are happy to advise you that a United States Seaplane Pilots Association has been formed. One of our objectives is to compile a very complete, up-to-date directory of seaplane bases throughout the country. We would like to have readers send us the address of any reputed base, for verification.

David H. Quam
P.O. Box 13
Little Ferry, N.J. 07643

• VFR/IFR Chart

Has consideration been given to introducing a light over-print of low altitude enroute (IFR) charts with significant terrain features and landmarks indicated? Such information would be very useful when you are filed IFR but encounter extensive VFR conditions and desire to make a few ground reference checks. It would not be necessary under these circumstances to handle both enroute and sectional charts.

Lester H. Vogt, Jr.
Euclid, Ohio

Yes, indeed. Consideration is presently being given to a means of combining visual and instrument features on a chart, although no concrete decisions have been made as yet. A number of pilots have expressed interest in a "VFR Radio Navigation Chart", which might resemble either an enroute chart, supplemented with visual information, or a visual chart with instrument information added or emphasized. FAA is developing an initial sample which will be evaluated by advisory groups from industry and pilots.

• Who Is Listening?

Since crash locator radios are now required for almost all aircraft I would be interested in the progress being made toward developing a universal means of receiving these distress signals. Why could not all communications receivers have the emergency frequency built into them, in addition to the selected frequency? Military sets have these, with a switch to turn it off if there is excessive noise. We in the Army National Guard at all times monitor the guard frequency, and in our newer aircraft we can monitor both the UHF and VHF. If all aircraft could do this the ELT would be really worthwhile.

Ltc. Russell H. Robinson
Davis, Calif.

Progress has been made toward developing an ELT monitoring program. All military, Coast Guard and FAA airplanes constantly monitor the distress frequencies while in flight. Also listening are the major Coast Guard vessels, FAA centers, flight service stations and towers. At FAA's request standards are being developed for low-cost lightweight monitoring, alerting and homing receivers for aircraft, especially for air carrier installation.

Even now the ELT is proving its value; we have documented about 20 recent rescues involving about 75 people. Typical was a single engine airplane ditching at sea about 80 miles off the coast of Greenland. More than 50 individuals reported hearing the distress signal and a successful recovery followed. In fact, to our knowledge, every airplane that has crashed with an ELT has been found, sometimes in minutes. (Ed. Note: see page 8 of March 1973 issue for article on this subject.)

• Accident Reports

Please advise the availability of published accident reports covering scheduled and general aviation operations, and subscription charges.

Major William F. Yeager,
USAF (Ret.)
Medina, Ohio

Reports of civil aviation accidents for air carriers and general aviation are now published by the National Transportation Safety Board, in about five volumes per year. Annual subscription charge for "Aircraft Accident Reports, Brief Format, U.S. Civil Aviation" is $20. Send check to National Technical Information Service, 5285 Port Royal Rd., Springfield, Va. 22151.

• Straight-In Approaches

Traffic patterns are quite well defined around controlled airports. How about the uncontrolled airport, without tower but with a FSS or active UNICOM?

FAR 91.89 says that all planes approaching to land will make all turns to the left unless the airport has approved light signals or visual markings indicating that all turns will be made to the right.

I can find nothing that says that a plane must enter any traffic pattern. Does this mean that a plane can make a legal straight-in landing to a non-controlled airport?

Omar Knedlik
Coffeyville, Kansas

It does. That is, a straight-in approach would be legal providing that it could be made without jeopardizing the safety of other aircraft in the pattern or on the ground. Pattern approaches with approved turns are recommended as a means of enabling the pilot to observe (and be observed by) the flow of traffic at an airport, when it exists. In any event, judicious use of the radio while approaching a non-controlled airport is always advisable. See "Voices in the Blue," an article on communications procedures at non-tower airports, in the January issue of FAA AVIATION NEWS.

• Vertical Speed Indicators

Why is the Vertical Speed Indicator designated as a "primary" instrument in the FAA Instrument Flying Handbook when it is *not* a required instrument (Part 91), nor is it listed in the FAA 10-year plan book for 1980 as a required instrument.

Richard H. Bidlack, Sr.
Boonton, N.J.

The Vertical Speed Indicator (VSI) is not required in FAR Part 91 because instrument flight can be satisfactorily accomplished using the other required pitch instruments. The VSI, when available, is an excellent supporting instrument for pitch control and is the primary pitch instrument when used as described in the handbook. When it is not available the airspeed indicator, gyro horizon, or the altimeter become the primary pitch instruments, depending on the maneuver being performed.

We currently require the VSI for air taxi passenger-carrying IFR flights. Consideration will be given to the inclusion of the VSI in Section 91.33 when Part 91 is next amended.

• Where Did the Frequency Go?

What is happening to the Control Tower "receive only" frequencies? During recent flights to Santa Barbara, Calif. and Grant Co., Wash. Santa Barbara announced 122.7R was being decommissioned and, at Grant Co. 122.7R was already decommissioned without a substitute such as 122.5R. Ground Control got me in and out of these airports.

Mike Lerom
Menlo Park, Calif.

You are right about 122.7 being no longer in use as a tower "receive only" frequency. Because of the shortage of frequencies for aviation use (particularly in the MHz spacing) and the great demand for those that are available, FAA is constantly analyzing the amount of use the various frequencies get. When it was determined that the "receive only" frequencies at towers were being used less and less, two of the three frequencies that had formerly been assigned to this purpose were reassigned.

These two frequencies, 122.7 and 122.4, are now in use by flight service stations as additional simplex or two-way communications frequencies. The remaining frequency, 122.5, will continue to be used to provide "receive only" service at qualifying towers—those which receive at least 50 calls per month, or have other special need for the service. (An article on this subject appeared in the March issue of FAA AVIATION NEWS.)

• Both Sides

The letter from Bernard C. Revoir (Flight Forum, December 1972) probably typifies the feelings of many private pilots concerning military aviation. Too much confusion exists between the private and military users of our airspace, and our lives depend on knowing a little about the other guy's missions. I would like to see you call attention to some of the facts concerning military flying—for example military aviation is only conducted for wartime application, and USAF planes can not use commercial fields except in certain closely controlled instances. And maybe some interest could be generated to have military aviation magazines publicize the private sector's operations.

I enjoy your informative magazine. After I read it from cover to cover it ends up in our squadron reading room.

Robert Lee Clark
Captain USAF
Thailand

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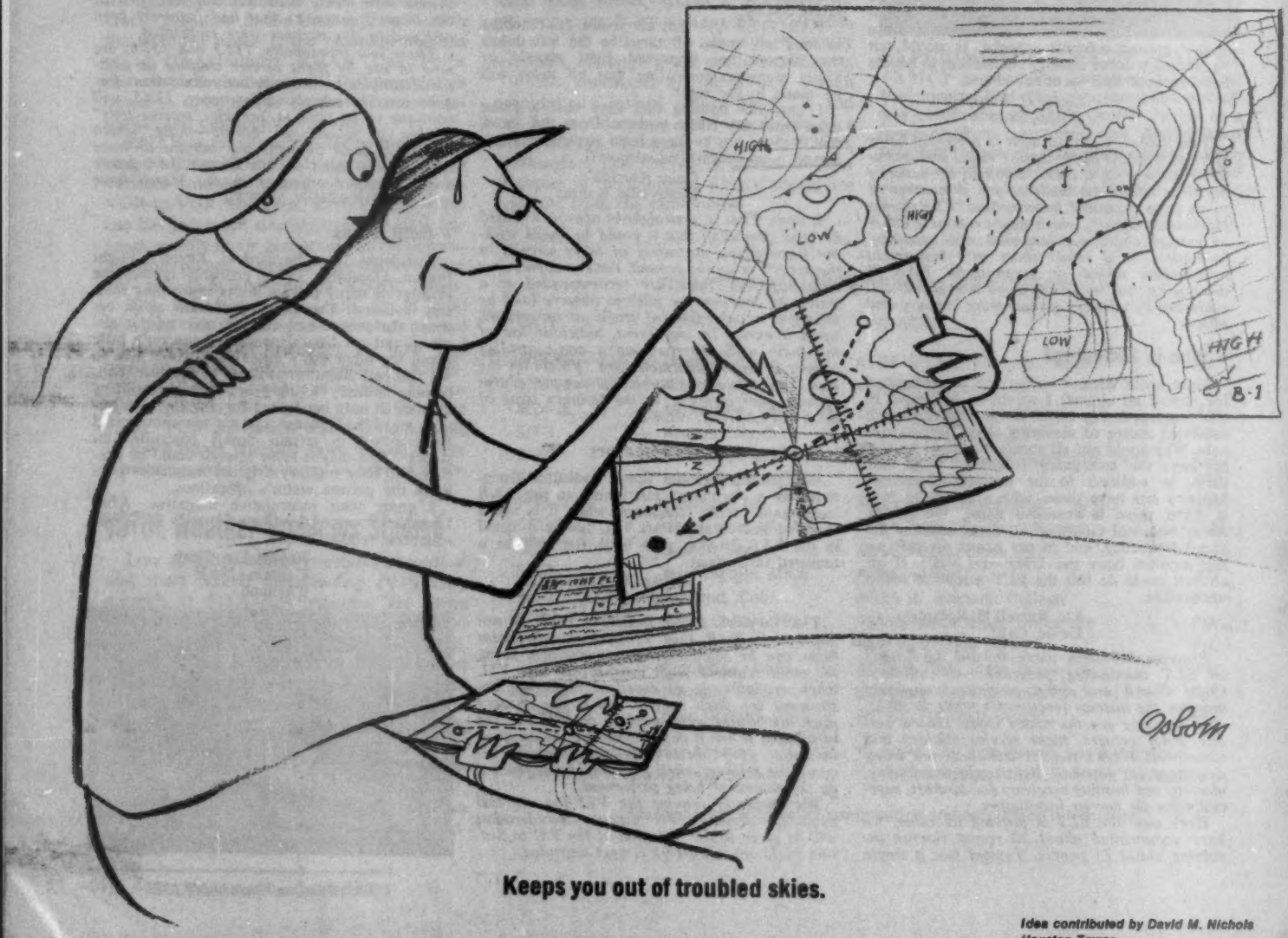
Understanding lows and highs



Keeps you out of troubled skies.

Idea contributed by David M. Nichols
Houston Tower